# Minutes of Meeting

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| VGB-Technical Committee: | Generation and Technology |
| VGB-Working Panel: | **PGMON** |
| | **Power Generation Maintenance Optimisation Network** |
| | **49th Meeting on 16/17 October 2014 in Arnhem** |

**Agenda**

**Welcome (Henk Wels)**

TOP 1: Biomass combustion in the CEZ group
Milan Andrejkovic, CEZ

TOP 2: Energy efficiency, New biomass plant, Transformer explosion
Henning Lundström, Hofor

TOP 3: Biomass combustion
Olegs Linkevics, Latvenergo

TOP 4: Failure data for life extension projects
Henk Wels, Dekra

TOP 5: Condition monitoring by smartsignal
Tom Staes, Laborelec

TOP 6: Primary resuperheater failure
Arjan van den Bos, NUON

TOP 7: LP turbine blade failure
Adolfo Gonzalez, EON

TOP 8: Future VGB, Phase 2
Heinrich Grimmelt, VGB

TOP 9: Place and date of next venue

VGB POWERTECH

**TOP 1:Biomass combustion in the CEZ group**
**Milan Andrejkovic, CEZ**

The presentation agenda is concerned to experience with biomass combustion in CEZ Group in Czech Republic.

First there was presented general information about activities of CEZ Group in Middle and East Europe and our future strategy in context of current economic situation on energy market.

Second there was shown structure of renewables sources of CEZ in Czech Republic and legislation conditions in relation to the combustion of biomass – 1) ways of biomass support in Czech Republic – three biomass categories and three combustion modes, in combination means nine levels of support. 2) Main changes in legislation in 2014: change of reporting, change in the supported kind of biomass, restrictions in imported biomass; and their consequences to biomass combustion in CEZ.

Example of Hodonin Heating and Power Plant - explanation of biomass application as a solution of fuel supply and samples of main technical issues and their possible solutions in low cost way.

**TOP 2:Energy efficiency, New biomass plant, Transformer explosion**
**Henning Lundström, Hofor**

BREF LCP

A new BREF LCP (BAT Reference document for Large Combustion Plants) is expected to be approved by the EU Commission in 2015/16. The existing BREF LCP only has recommendations where as the new edition has conclusion i.e. the EU members are obliged to implement these conclusions within a time frame of 4 years.

One of the new conclusions concerns the design energy efficiency at full load. A special Task Force for Energy Efficiency (TFEE) was formed in the beginning of July 2014 to work out a questionnaire to collect data to indentify the appropriate values for energy efficiencies for the various combustion techniques.

The PGMON group had a resume of the work for setting up the questionnaire.

Short descriptions of a new bio mass fired CHP unit to be build at the Amager Power Plant in Copenhagen.

The new unit is one of the measures for the Copenhagen Municipality to be a CO2 neutral capital in 2025 by supplying environmental friendly district heating, district cooling, and power supply.

The unit shall have $deNO_x$, $deSO_x$ and dust reducing techniques to comply with the new IED.

Energy efficiency is essential for the CHP plant and the boiler shall be designed with a condensation unit for heat recovery from the flue gas.

The new combined district heating and power plant (CHP) unit will be equipped with a 500 $MW_{th}$ CFB boiler intended for wood chips, but also other types of bio mass will be possible. Expected design values for live steam conditions are 170 bars and 520°C.

The turbine will be designed as a back pressure. Design capacities will be approx. 160 MWe and 250 MJ/s district heating. The turbine will have a 100 % by pass whereby the district heating capacity increases.

Fuel logistics will be one of the challenges as the new unit demands 4.3 million $m^3$ wood chips per year. Due to variety in skip sizes the harbor shall be able to handle ships on an everyday basis all the year.

The new CHP unit is planned to be in operation 2020.

Explosion in voltage transformer

Early 2014 an extreme explosion took place in an indoor high voltage substation only 20 meters away from the Amager Power Plant in Copenhagen. No persons were hurt - the explosion took place at 01 o'clock at a Sunday morning - no personal were present in the area.

The damages inside the high voltage station were severe; bus bars in the ceiling had loosened and some the reinforcing steels in the concrete construction were pulled apart. A steel gate was – despite its weight of 700 kg - pushed 20 meters over the street and spoiled another steel gate in the façade of the power plant.

The voltage transformer is rated 132 kV : 110 V and had been in operation for 9 years. The voltage transformer only contains a minimum of oil. Properly an internal insulation failure has started the steps leading to the extreme explosion. Unfortunately the failure report from the supplier has not been published yet.

During the yearly overhaul in the Amager power Plant the regular oil tests at an equivalent voltage transformer showed 2 ppm content of acetylene in the oil. Acetylene is formed due to sparks in the oil.

The voltage transformer has been taken out of operation until more details are available.

**TOP 3:Biomass combustion**
**Dr. Olegs Linkevics, Latvenergo**

To be added later

**TOP 4: Failure data for life extension projects**
**Henk Wels, Dekra**

Our history of applying Reliability Availability Maintainability (RAM) data to Life Extension projects (LTE) projects goes back some 10 years. The applications are:

1) One plant of 2 sister units from the 70-ties, with supercritical Benson boilers. Both units were cycling with minimal maintenance budgets. We have developed a work flow diagram, made a reliability block diagram to forecast RAM and analyzed the failure data. As the LTE activities were already defined, we estimated the improvement in RAM. This was based on factors for normal failure probabilities in relation to failure probabilities for plant components on which (due to projects at these plants) we were sure that minimal maintenance was applied. A Life Cycle Cost LCC model was constructed and applied to rank the LTE activities on profit versus costs.
2) For a plant that had a large extension (therefore unplanned) of the outage during which LTE projects were carried out with several unplanned outages following, we helped investigating and improving the business cases for LTE. Failures were modelled on the basis of a plant walk down, documentation and interviews with experts using expert knowledge in combination with historical info. We set up a LCC model containing time dependant failure behavior, High Impact Low Probability (HILP) failures and uncertainty using Monte Carlo techniques with @RISK.
3) For a plant in Australia we carried out a LTE study according to our Advance Life Time Assessment (ALTIMA) concept. In addition to a quick scan Failure Mode Effect Analysis FMECA at location for pinpointing the dominant components, we carried out inspections

including Non Destructive Testing (NDT). Again, a LCC model was set up. Report to plant management was carried out using explicit statements on the condition (good, bad, ugly) based on the opinions and facts encountered. Interestingly, the NDT showed that some components could be operated for another period while opinion before the NDT indicated replacements and repairs. Furthermore we found that opening the steam turbine was justified in this case.

4) Recently we applied RAM data to LTE of power plants delivering district heat (DH). The process scheme for the DH part is complicated due to the series and parallel configuration of the heat exchangers and the modeling has to be carried out in close cooperation with plant experts. We used the VGB KISSY data in next to plant specific historical data and expert judgment to assess the RAM expected. The RAM models clearly showed which components were critical and a ranking was carried out. We set up a more detailed LTE work flow diagram decision making diagram taking inspections etc. into account.

With regard to lessons learned, we consider the application of failure data meaningful to rank components and predict forced unavailability (EFOR) before and after LTE projects on components. We consider the relation between condition of a component (with the trajectory to failure) and historical / generic failure data still missing, a point that should be investigated further also to apply meaningful RCM analysis using p-F intervals (time between start of degradation and failure). Finally we note that decision making during and after LTE studies may result in results that are different from the LTE optimum scenarios. For example, the plant may be converted to another configuration before the end of the LTE scenario implemented and components may still be in operation without failure despite predictions of imminent failures.

**TOP 5:Condition monitoring by smartsignal**
**Tom Staes, Laborelec**

In asset management, different roles may be distinguished, sometimes organized within different entities (companies like GDF SUEZ), sometimes as different responsibilities within one company.

The asset owner is responsible for business values, strategy, budgets and profit & loss. The asset manager is responsible for executing the business strategy by defining plans and procedures, and deciding on quality and capacity issues, trading off: maintenance, refurbishment and replacement (MRR). The service provider is responsible for executing the asset manager’s plan.

Translated into maintenance, the asset owner defines the maintenance strategy and provides the budget; the asset manager decides on MRR and defines the maintenance program and the work orders or service agreements with the service providers; and the service provider carries out inspections, measurements and maintenance activities and reports back to the asset manager.

Preventive, predictive or run to failure (reactive)

*FMEA to Riks Analysis (FMECA )*

- *Evaluate criticality*
- *Identify potential problems*
- *Propose solutions to mitigate the impact of failures or to avoid non optimal operation*

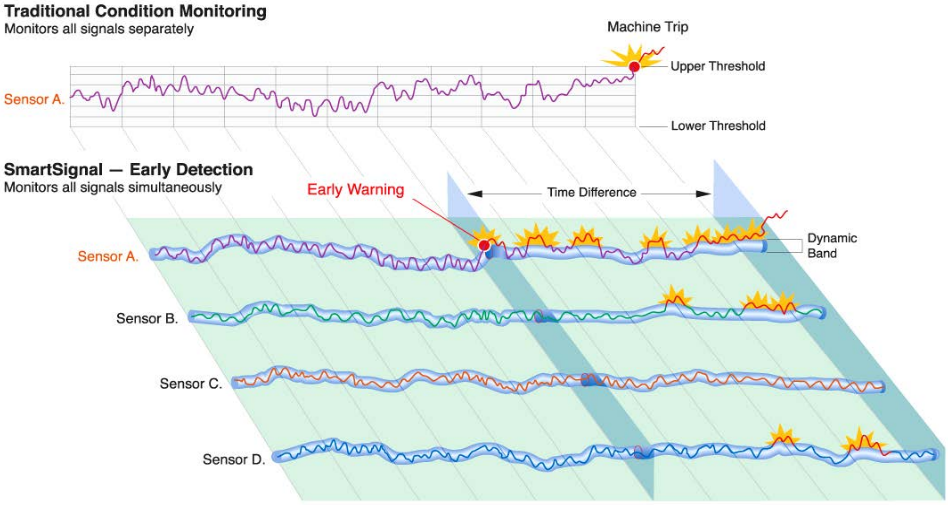
*Severity (S) -*
*Occurrence (O) - LIKELIHOOD*
*Detection (D)*

MM-tool can only be succesfull in total AMS wich leads to O&M-strategy.

We are still to much in the early-fault-detection phase and as such people are expecting it to much to be the end solution. It is a tool it is not the solution.

High M cost are a direct result of inherent problems throughout the plant and not just ineffective M. Poor design standards, purchasing "bad" pratices, improper operation and outdated mgmt methods. This technology can be used to predict efficency degradation, caracteristics deviation and

When the degradation process is gradual, previous observation or measurements give sufficient confidence that the equipment will survive the time interval until the next inspection, measurement or repair job.




- Dynamic bands represent the estimated value for each sensor plus or minus an allowable variance (based on model tuning)
- Readings that exceed the dynamic bands trigger alerts
- Persistent alerts trigger incidents, usually after 3 hours (15/18)

**TOP 6:Primary resuperheater failure**
**Arjan van den Bos, NUON**

To be added later

**TOP 7:LP turbine blade failure**
**Adolfo Gonzalez, EON**

On 4th February 2014 a process safety accident occurred at the unit 1 of the E.ON´s power plant at Ironbridge which eventually led to the early closure of the unit since this was uneconomical to repair. This presentation provides some background of the power plant and its operation and maintenance; a description of the accident and a brief overview of the investigation process, finally listing findings and recommendations.

The Ironbridge power plant comprises two 370 MW units. They were opted-out for the Large Combustion Plant Directive (LCPD) in 2008. According to this choice the units should be closed by the end of 2015 or when they have run for 20.000 h, whatever happens first.

These units have historically burned coal but were converted to biomass in 2012. After such conversion they have operated burning solely imported wood pellets and a maximum of 20% coal. Fuel is delivered to site by railway from the Liverpool Bulk Terminal.

On February 2014 the generator of unit 1 suffered a rapid Hydrogen fire and afterwards a longer-lasting oil fire while the unit was starting up. The unit tripped due this incident and unit 2 was shut down as well to prevent any further risk.

The generator and the main exciter were destroyed by the accident and 12 last-stage blades were unaccounted for in the LP section closest to the generator.

An investigation was conducted and it was identified that the incident had initiated in an LP last-stage blade which had failed due to high cycle fatigue. This mechanism of failure could be caused by either blade flutter or forced vibrations, both mid-term. It could not be concluded which one was the initiator although blade flutter seems more likely.

The operation and maintenance history of both units was checked so as to try to identify any root cause. The only relevant difference found was that unit 1 had had for a year ca. 20°C lower LP exhaust temperature which was never regarded as an issue, rather as an advantage since it improved the vacuum in this unit.

The valve which allowed water to flow to the exhaust hood sprays was found open in its test position. It had been in that situation for a year, allowing water to flow anytime the pumps were running, during start-ups.

It was also noticed that the unit had been running in Full Speed / No Load (FSNL) for extended periods of time (ca. 1 hour) to reduce vibrations caused by the shrunk-on design of the rotor.

It was concluded that the combined effect of FSNL running and exhaust hood spraying set the conditions which caused the blade flutter.

All the LP blades in unit 2 were inspected and all water droplet erosion marks ground before considering this unit safe to return to service. The water spray valve was checked and found working correctly.

Unit 1 was officially closured in May 2014 after considering it uneconomical to repair and the lessons-learnt from this incident are been shared with the industry so as to prevent similar incidents from occurring anywhere else.

**TOP 8:Future VGB, Phase 2**

**Heinrich Grimmelt, VGB**

On the meeting in Berlin the project Future VGB was extensive presented.

Because of reducing capacities within VGB the strategy is to safe a number of committees by bundling of topics. The suggestion was to integrate the PGMON group into the “Maintenance management” group.

Now the group had to talk about the consequences for itself.

First the language was mentioned. Some participants can understand german language others don´t. It was mentioned that in case participants of the MM group can´t understand german the whole meeting would be held in English language. Some of the members refused to be the one who forced a whole group into another language.

Second it was criticized that there was not enough time for the exchange of experience in the agenda. In the PGMON group each member gets an hour time to present.

At least it was unanimous decided to keep the group meetings as they are.

**TOP 9:Place and date of next venue**

The next meeting will be held on 15/16 April 2015 in Riga.